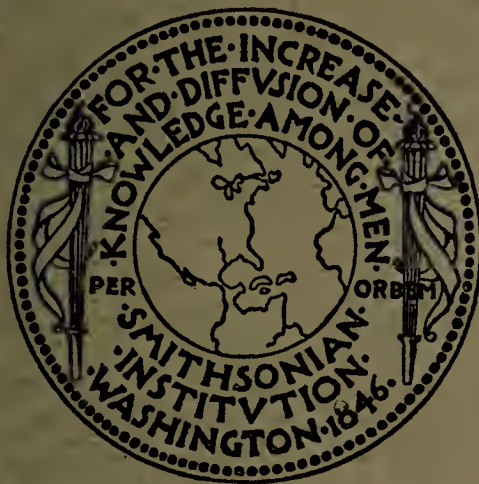


SIR JAMES DEWAR, F. R. S., LL. D.

BY

SIR JAMES CRICHTON-BROWNE, M. D., LL. D., F. R. S.

FROM THE SMITHSONIAN REPORT FOR 1923, PAGES 547-553
(WITH 1 PLATE)



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MISS OLIVE EDIS. F. R. P. S.

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By Sir JAMES CRICHTON-BROWNE, M. D., LL. D., F. R. S.

[With 1 plate]

A great man of science has passed away, resolved into that atmosphere the secret of which he has done so much to disclose. Sir James Dewar died on March 27 at the Royal Institution in Albemarle Street, which has been for 46 years the scene of his labors; and his remains were, by his express wish, cremated at Golder's Green on the following Saturday.

Born at Kincardine-on-Forth under the shadow of the Ochill Hills, and near Stirling with all its romantic historical associations, on September 20, 1842, Sir James Dewar was reared in a Presbyterian home and was early introduced to the austere theology in the Shorter Catechism. In his tenth year there occurred an incident which probably colored his life. While skating on a winter's day he fell through the ice, and when rescued walked about in his wet clothes till they were dry, so that his family might not learn of his misadventure. The result of that was that he had a severe attack of rheumatic fever, which crippled him for two years and left him with a damaged heart. The heart trouble incapacitated him for the active life to which he had been previously disposed and permanently cut him off from strenuous games and exercises, but in no degree impaired his constitutional energy, which remained intact and unsurpassable till his death. It was in these two years when he was laid aside, free from schooling, with only a modicum of private tuition and cut off from the companionship of other boys of his age, that his native gifts had a favorable opportunity of spontaneous growth. He browsed unconfined on the wholesome pastures of English and Scottish literature, drank deeply of Burns, and above all, began to think for himself and to create; and creation is the essence of all genius. Always devoted to music, he had before his illness attained to some degree of proficiency on the flute, but was now debarred from that instrument by breathlessness, and so turned to the violin. With the help of the village joiner he made for himself several violins, one of which, wonderfully expressive in its tones, was played on at the celebration of his golden wedding in 1921.

¹ Reprinted, by permission, from *Science Progress*, July, 1923.

When 12 years old Dewar, still a pale and delicate boy, went to the Dollar Academy, a Scottish secondary school of high repute, of which he always spoke very gratefully, and there he resumed the ordinary routine of the education of the period. It was a little incident at Dollar, the discovery in the garden of Mr. Lindsay, the master with whom he was boarded, of an old and half-buried sundial, in the erection and orientation of which he took some part, that inoculated him with a taste for exact science; but it was not until he went to the University of Edinburgh, at the age of 17, that his apprenticeship to science really began. There he soon diverged from the accustomed literary course and plunged, as it were instinctively, into mathematics, physics, and chemistry. In this congenial element his ability was speedily recognized by two of his professors, Guthrie Tait and Lyon Playfair, the latter of whom made him his class assistant. There was great intellectual activity in Edinburgh while Dewar's lot was cast there in the sixties of last century, and into that he entered with zest and with an acceptance not usually accorded to so young a man. His teaching power attracted large classes to his practical demonstrations, and the experimental tendencies, which were in the marrow of his bones, unmistakably displayed themselves, leading Lyon Playfair to suggest to him that he should accept an appointment for technical work in connection with the dyeing industry with which his friend Crum Brown, who became Playfair's successor, was, by family ties, associated. Had Dewar adopted this course Perkins might have been anticipated, but he preferred to remain in Edinburgh to carry on his less circumscribed researches there, in the meantime, however, enlarging the scope of his studies by a sojourn at Ghent, where under Kekuli he gave special attention to organic chemistry.

Returning to Edinburgh as demonstrator of chemistry in the university, he engaged, with Guthrie Tait, in experiments with Crookes's newly invented radiometer, and with McKendrick in an inquiry on the physiological action of light. From the university he passed to the Dick Veterinary College as professor of chemistry, and it was while diligently working there that an offer of promotion unexpectedly came to him. There was a vacancy in the Jacksonian professorship at Cambridge, for which there were several candidates, and a selection was imminent, but at this moment the late Sir George Humphrey visited Edinburgh as an examiner in the medical faculty and was introduced to Dewar. With keen discernment he took his measure and immediately telegraphed to Doctor Porter, then tutor, afterwards master of Peterhouse, "Hold your hand, I have found the man." At the same time Guthrie Tait wrote to Cambridge indicating Dewar, and that settled the matter, and the post was of-

ferred to him by telegram. He was busy and happy, a brilliant career in Edinburgh, almost inevitably culminating in a professorship, was opening out before him; but his young wife, with sure intuition, felt that he deserved a wider field than Scotland could afford, and so the die was cast, and the migration to Cambridge took place.

It would not be correct to say that Dewar found himself in a congenial element in Cambridge at that time. His lectures were an unprecedented success; he made some lifelong friends, of whom one, Professor Liveing, much loved and venerated, still happily survives, but some bristles of the Scottish thistle adhered to him, and chemistry and physics had not then come to their own on the banks of the Cam. He had not even such facilities as he had enjoyed in the north. His laboratory was a small room, without a fireplace and badly lighted; apparatus was conspicuous by its absence; and his aspirations, very forcibly expressed, were not very sympathetically received. It was, therefore, with satisfaction that he found himself translated to a more elastic atmosphere when in 1877 he was elected Fullerian professor of chemistry at the Royal Institution in succession to Dr. John Hall Gladstone.

It was in the laboratories of the Royal Institution during his incumbency of the Fullerian professorship that all Dewar's triumphs were achieved, more especially those in connection with the liquefaction of gases and the properties of matter at temperatures approaching the absolute zero. Faraday, the god of his idolatry in all scientific affairs, had led the way in this exploration and had by means of low temperature and pressure succeeded in liquefying all the then known gases except nitrogen, oxygen, and hydrogen, and the compound gases—carbonic oxide, marsh gas, and nitric oxide—and as early as 1874 Dewar was fascinated by the subject, as evidenced by his lecture before the British Association on "Latent heat of liquid gases." In 1878 he showed Cailletet's apparatus in operation in England. It was, however, the success of Wroblewski and Olszewski, of Cracow, in liquefying oxygen in 1884 that withdrew him from his earlier preoccupation, with the heat of the sun, electrophotometry, and the chemistry of the electric arc, and supplied the stimulus to his more memorable discoveries. In 1885 he was able to show a profoundly moved audience at the Royal Institution the air we breathe made visible as a clear liquid, compressed to one eight-hundredth of its bulk and produced at a temperature of -192° C. In 1893 came oxygen in a solid state, an ultramarine ice produced at -216° C., and in 1897 fluorine as a fluid. In the following year appeared liquid hydrogen, and in 1899, a crowning close of the century, that gas in a solid state at a temperature of -260° , or about 13° above the point of

absolute zero, that unplumbed depth where molecular movement is no more. Helium alone remained unsubjugated by Dewar, and that he would unquestionably have liquefied had not Onnes, of Leyden, working on his lines, accomplished the feat while he was preparing for it.

Now that liquid air is an article of commerce, Dewar's liquid-air work has become popular knowledge, but only an expert who has essayed such an enterprise can conceive the patience, the industry, the ingenuity, the constructive genius required in it. Dewar devoted to it years of unremitting toil and pursued it not without risk to life and limb, and sometimes embarrassed by the question of ways and means to carry on so costly a campaign. To obtain a degree of cold sufficient to liquefy hydrogen by means of internal work done by the molecules while a gas was being forced through a porous plug, involved the building up of a machine capable of sustaining pressure in many tons to the square inch, even at a temperature of -260° C., and fitted together with a nicety and precision of which even first-class engineering knows little. To protect the liquid gases when produced against the influx of heat, special measures were necessary, and the search for these led to the invention of the vacuum bulb, the parent of the thermo flask which Dewar's nimble brain devised, which must have brought him a huge fortune had he chosen to patent it, and which, if properly designated, should keep his name alive for ever, even amongst the masses of mankind. But the vacuum bulb, even when silvered, was not enough. In order to examine the liquefied gases in a static condition, and unevaporated for long periods, specially high vacua were needed, and these were procured by Dewar's utilization of the absorptive power of carbon. "The discovery of the marvelous power of charcoal to absorb gases at low temperature," says Professor Armstrong, "will render the period 1900 to 1907 ever memorable."

Dewar's liquefied gases, thus obtained, became themselves instruments of research, and enabled him to conduct novel and illuminative investigations on electrical conductivity, thermo-electric powers, magnetic properties, and electric constants of metals and other substances at low temperatures and on the effects of extreme cold on chemical and photographic action. Having established that chemical changes are almost quite inhibited at temperatures about 300° F. below zero, Dewar, with the assistance of Professor Macfadyen, determined to test how far vital processes were affected by the same conditions. A typical series of bacteria was employed for the purpose, possessing varying degrees of resistance to external agents. The bacteria were first simultaneously exposed to the temperature of liquid air for 24 hours. In no instance could any impairment of their vitality be detected in either growth or functional activity.

This was strikingly illustrated in the case of the phosphorescent organisms. Their cells emit light which is apparently produced by chemical processes of intracellular oxidation, and the phenomenon ceases with the cessation of their activity. These organisms, therefore, furnished a crucial test of the influence of low temperature on vital manifestations, and when cooled down in liquid air they immediately became nonluminous, but, on being thawed, the luminosity as speedily returned. In further experiments the organisms were subjected to the temperature of liquid air for seven days. The results were again nil, for on thawing they renewed their life processes with undiminished vigor. The organisms were next exposed to the temperature of liquid hydrogen—only 28° above the absolute zero—and again the results were nil. The fact that life can continue to exist at a temperature at which, according to our present conception, molecular action ceases and the entire range of chemical and physical activities, with which we are acquainted, either ceases or enters on an entirely new phase, affords ground for reflection, as to whether, after all, life is dependent for its continuance on chemical reactions.

Dewar's heroic attempts to reach the absolute zero of temperature, solving problems of supreme importance and intricacy by the way—time-and-strength-consuming though they were—did not exhaust his scientific energies or complete his conquests. As a member of the Explosives Commission in 1888, in conjunction with Sir Frederick Abel, he invented cordite, which became the standard smokeless powder, and during the war he contrived a light and portable apparatus for the conveyance of oxygen so that it might be available as a protection against mountain sickness for men going up in airplanes. He conjured up giant soap bubbles that survived for months, because the air inflating them was like Bonny Kilmenny, "as pure as pure can be," and spread out films of extreme tenuity that in their stream lines and vortex motion yielded to his manipulations, assemblages of dancing rainbows of exquisite beauty. He took part in many inquiries bearing on the public health and especially on the safeguarding and improvement of our water supply, and was a much sought and inexorable witness before committees of Lords and Commons. Along with Professor Liveing, he conducted an elaborate series of studies on spectroscopy that have now been collected in a volume, and would by themselves place him in the first rank as a man of science.

Besides doing his own work, Dewar was the cause of much work in others. He was eminently suggestive and freely helpful to all who sought his assistance. He did not suffer fools gladly, and was intolerant of pretentious mediocrity; but for the earnest student and

honest worker he had unfailing sympathy and encouragement. The fruits of his experience and the seeds of his speculations—and hypotheses of the right sort are valuable commodities in science—were always at the service of those who consulted him. And it is certain that ideas which he thus flashed forth have afterwards, without acknowledgment, materialized in profitable inventions.

Dewar identified himself with the Royal Institution and the Royal Institution became identified with him. He pervaded it so that many of its habitués entering it now feel as if the soul had gone out of it. The scene of his labors became the object of his affections, and he never spared himself in its service. Proud of its traditions, and conscious of the opportunities it had afforded him, he strove to enhance its reputation and extend its usefulness. He made liberal benefactions to its funds, and was wont to enlarge on the magnitude of its accomplishment with the very meager means at its disposal, pointing out that the fundamental ideas and experiments on which are based the stupendous chemical and electrical industries of to-day were worked out in its laboratories by Davy, Faraday, Tyndall, and himself at an average expenditure on research of £1,000 a year.

During his period of office at the Royal Institution Dewar delivered 238 lectures in all—49 Friday evening discourses, 48 Christmas lectures, and 151 afternoon lectures. As his lectures were no off-hand demonstrations, but carefully prepared expositions, every experiment being previously rehearsed, they entailed a heavy drain on his time and energy. In the 10 years—1884 to 1893—he delivered six of those Christmas courses of lectures to juveniles, which make peculiarly exacting demands on minute attention and lucid expression, dealing with subjects as varied as “Alchemy,” “Meteorites,” “The air,” “Clouds and cloudland,” “Frost and fire,” “Light and photography.” It was by the allurements held out by him that the late Dr. Ludwig Mond was induced to make to the Royal Institution the munificent gift of the Davy Faraday Research Laboratory, which affords unique opportunities to those individual and independent investigators on whom Dewar’s hopes for the advancement of science were mainly fixed.

Dewar had a singularly impressive and attractive personality. He had a head like Shakespeare, a countenance finely chiseled, expressive of vivid intellect and abounding vim blended with good humor. He gave the world “assurance of a man,” a strong true man, open hearted and open minded, quick of temper perhaps, but genial and generous withal, a staunch friend, a delightful companion. With a proper endowment of the *ingenium perfervidum Scotorum*, he was sturdy in spirit, intrepid in manner, fearless, patriotic, and given to hospitality. No one could be more inimical

than he to the occult in all its phases, and yet the press has been not altogether wrong in ascribing to him a certain wizardry—"the wizard of Albemarl Street" they have called him—for he was a wonder-worker and threw a spell over his audience. Bent on the pursuit of reality and on the control of nature through the advancement of knowledge, there was scope in the amplitude of his mind for ideal values. He had imagination, which is the forerunner of science, "the vision and the faculty divine," and was a connoisseur in music and the fine arts. On the bookshelves in his study, within reach from his easy chair, were assembled well-worn copies of the essays of Montaigne, Elia, and Emerson; the poems of Hardy, Walt Whitman, Rossetti, and Meredith; Landor's *Imaginary Conversations*; Carlyle's *Heroes*; *Sesame and Lilies*, and the *Cricket on the Hearth*.

Dewar was knighted in 1904, and that was the only and wholly inadequate recognition offered to him by his country, to which he brought honor and profit. But foreign countries and learned bodies were more appreciative of his merits than the dull-witted ministers at home. The royal and philosophical societies and academies of Rome, Belgium, New York, Philadelphia, Frankfort, Milan, and Copenhagen were proud to inscribe his name on their rolls, and all the four Scottish universities, as well as those of Oxford, Dublin, Brussels, and Christiania, conferred on him honorary degrees. The Royal Society awarded him its Copely, Rumford, and Davy medals, and he was president of the British Association in 1902.

Sir James Dewar married in 1871, Helen Rose, daughter of Mr. William Banks, of Edinburgh, and she survives him. Never had savant a more propitious spouse. Lady Dewar entered keenly into all her husband's interests, sustained him in his heavy tasks, and created the first scientific salon in London. There are few noted people in the world of science who have not attended the receptions in her drawing room at the Royal Institution after lectures there.

